M001: CHARACTERISTICS OF MOUNTAIN ENVIRONMENTS

TSP Number/Title	M001: Characteristics of Mountain Environments
Effective Date	Implement next class iteration upon receipt
Supersedes TSP(s)/Lessons	None
TSP User	The following courses use this TSP: Mountain Instructor Qualification Course (MIQC) Basic Mountaineering Course (BMC) Assault Climbers Course (ACC)
Proponent	United States Army Alaska, Northern Warfare Training Center
Improvement Comments	Send comments and recommendations on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: ATTN: TRAINING ADMINISTRATOR COMMANDANT USARAK NWTC 1060 GAFFNEY ROAD #9900 FORT WAINWRIGHT AK 99703-9900
Security Clearance/Access	Public domain
Foreign Disclosure Restrictions	The Lesson Developer in coordination with the USARAK NWTC foreign disclosure authority has reviewed this lesson. This lesson is releasable to foreign military students from all requesting foreign countries with Approval of Commandant USARAK NWTC.

PREFACE

Purpose

This training support package provides the instructor with a standardized lesson plan for presenting instruction for:

Task Number	Task Title
I.0200	Mountain Environments

Technique of Delivery

Lesson Number	Instructional Strategy	Media
M001	Platform Instruction	PowerPoint

This TSP contains

M001: CHARACTERISTICS OF MOUNTAIN ENVIRONMENTS

SECTION I **ADMINISTRATIVE DATA**

All courses including this lesson

Course Number(s)	Course Title (s)
	Mountain Instructor Qualification Course
	Basic Mountaineering Course
	Assault Climber Course

Task(s) Taught or Supported

Task Number	Task Title
I.0100	Describe the characteristics of mountain environments.

Task(s) Reinforced

N/A

Test Lesson Number

Hours	Lesson Number	Lesson Title
1	M020	BMC Mountaineering Review

Prerequisite Lesson(s)

None

References

Number	Title	Date	Additional Information
	NWTC Mountain Operations Manual	FY04	Updated yearly
FM 3-97.6	Mountain Operations	November 2000	http://www.adtdl.army.mil/
FM 3-97.61	Military Mountaineering	August 2002	http://www.adtdl.army.mil/

Student Study Assignment	Students should read M001
Instructor Requirements	MIQC graduate, TAITC graduate
Additional Support Personnel Requirements	One assistant to run PowerPoint slide show.
Equipment Required	Computer with proxima capable of running PowerPoint presentations.
Materials Required	Instructor Materials: • NWTC Mountain Operations Manual • Risk Management for Mountain Operations Student Materials: • NWTC Mountain Operations Manual • Risk Management Guide for Mountain Operations
Classroom, Training Area and Range Requirements	Classroom of adequate size
Ammunition Requirements	None
Instructional Guidance	Before presenting this lesson, instructors must thoroughly prepare by studying this lesson and identified reference material.

Branch Safety Manager Approval

NAME	Rank	Position	Date
Mark Gilbertson	**GS-09**	**Training Specialist**	

Proponent Lesson Plan Approvals

NAME	Rank	Position	Date
Peter Smith	**GS-12**	**Training Administrator**	

SECTION II **INTRODUCTION**

Method of Instruction: Platform
Instructor to student ratio: 1:75 (maximum)
Time of instruction: 50 minutes
Media: Computer with proxima

Motivator

Characteristics of Mountain Environments

Reference NWTC Mountain Operations Manual, TSP M001; FM 3-97.6, Mountain Operations; FM 3-97.61, Military Mountaineering

The U.S Army has a global area of responsibility and deploys to accomplish missions in both violent and nonviolent environments. With approximately 38 percent of the earth's landmass classified as mountains, the Army must be prepared to deter conflict, resist coercion and defeat aggression in the mountains as in other environments. Expertise in mountain operations cannot be gained solely from reading material on mountain operations or perusing a PowerPoint presentation; to develop a solid foundation in mountain warfare, both applicable training and operational experience is essential. It must be stressed that there is no substitute for field experience.
(Slide 1) I am --- ------. During this block of instruction we will discuss the characteristics of mountain environments.
Instructor notes for use as information for the motivator:
From Military Review-CGSC Ground Combat at High Altitude: 'High mountain terrain is often inaccessible, uninhabitable or of no apparent value, yet peoples and states still fight to possess it. Long, bloody wars have been fought, and are being fought, for mountain real estate located between 10,000 and 23,000 feet [3050 and 7015 meters]. Over the past fifty years, high-altitude combat has raged in Africa, Asia, and South America. The Chinese invaded Tibet in 1953 and fought a subsequent guerrilla war there until 1974. From 1953 to 1958, British troops fought Mau-Mau separatists in the Aberdares Mountains of Kenya. In 1962, China and India battled in the Himalayan Mountains bordering Bhutan and Tibet. Soviets fought Afghan Mujahideen in the towering Hindu Kush Mountains from 1979 to 1989. The Peruvian government hunted the Sendero Luminoso guerrillas in the Andes Mountains throughout the 1980s. India and Pakistan have continually battled for possession of the Siachen Glacier since April 1984 and fight sporadically over disputed Kashmir as they have since 1948. Today, Colombia's government troops are fighting the Revolutionary Armed Forces of Colombia (FARC), and the National Liberation Army (ELN) guerrillas high in the Andes, and

Russian soldiers are fighting Chechen separatists high in the Caucasus Mountains. The U.S. Army has little experience fighting in truly high mountains and its mountain warfare manuals deal primarily with low and medium mountains and stress the use of helicopter aviation to conduct that combat. However, helicopters cannot haul normal loads over 13,000 feet [3965 meters] since their rotors lack thick enough air to "bite" into, and high altitude weather conditions will frequently shut down flying for days. High-altitude combat differs from medium- and low-mountain altitude combat and requires a different orientation and force structure. Other armies have experience in truly high mountains and can provide valuable guidance and expertise. The U.S. Army needs to know how to conduct high-altitude mountain warfare, develop the tactics, techniques, and procedures to do so, and share the experience of other armies to understand and prepare for possible high-altitude conflicts.'

Terminal Learning Objective

At the completion of this lesson you (student) will:

ACTION	Describe the characteristics of mountain environments
CONDITION	In a classroom environment.
STANDARD	Describe the characteristics of mountain environments IAW the NWTC Mountain Operations Manual.

Safety Requirements

None

Risk Assesment Level

Low

Environmental Considerations

None

Evaluation

Students will be evaluated on the comprehension of lesson material by a written test.

Instructional Lead-in

(Slide 2) In this class we are going to discuss the following topics:

Characteristics of Mountain Environments

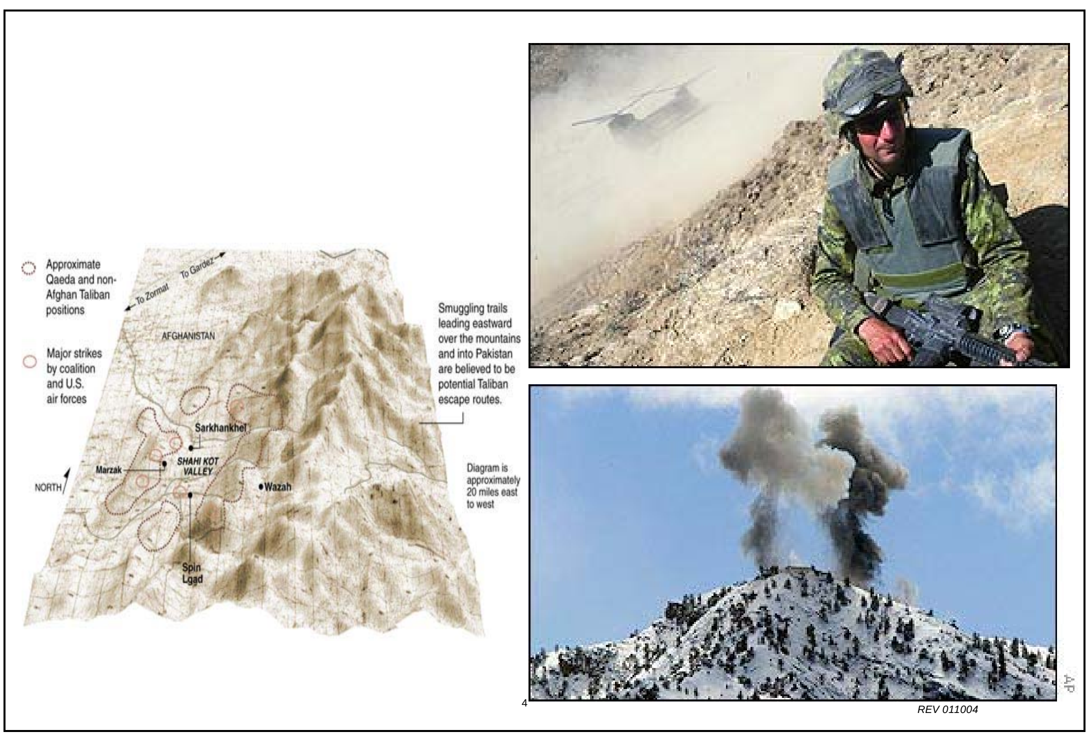
Terrain
- ***Mountainous Regions of the World***
- ***Terrain Characteristics***

Climate and Weather
- ***Mountain Weather***
- ***Weather Prediction***

Hazards and Phenomena of Mountainous Regions

(Slide 3) Pakistani Army patrol moving out in the Siachen Glacier area – a conflict with India that has been ongoing since 1984.

(Slide 4) Recent operations in Afghanistan took place in a mountainous region at elevations of 10,000 to 17,000 feet – Operation Anaconda was conducted against well fortified Taliban and Al Qaeda forces. They fought from the high ground, while coalition troops were forced to fight from a valley up. Canadian with Chinook during Operation Anaconda. Taliban/Al-Qaeda positions hit with indirect fires during Operation Anaconda.



SECTION III **PRESENTATION**

ELO A

ACTION	Describe the general characteristics of mountain ranges
CONDITION	In a classroom environment
STANDARD	Describe the general characteristics of mountain ranges IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations.

Learning Step/Activity 1 – General terrain characteristics

a. (Slide 5) Mountains are generally defined as land masses which rise higher than 1000 ft. above the surrounding terrain, and are characterized by steep slopes. Mountains may be composed of exaggerated terrain features, heavy woods or undergrowth, rocky peaks, glaciers, snowfields, escarpments, and extremely erratic weather conditions. Slopes in the mountains generally vary from 15º to 45º, while cliffs and precipices may be vertical or even overhanging. Mountains may consist of isolated peaks, single ridges or complex ranges extending for many miles.

Terrain

- ***Isolated peaks and complex ranges***
- ***Significant local relief (1000 ft. or more)***
- ***Steep slopes (generally 15 to 45 degrees)***
- ***Vertical obstacles, swift streams, ravines, gorges***
- ***Heavily forested or sparse vegetation***

b. (Slide 6) General categories of mountains: Mountains are generally classified as low or high depending upon their local relief and to some extent elevation. Low mountains have a local relied of 1000-3000 feet (300-900 meters) with summits that are below tree-line. High mountains generally have a local relief exceeding 3000 feet (900 meters) and are characterized by barren alpine zones above timberline and difficult forested areas below timberline. Glaciers and perennial snow cover are common in high mountains and usually present commanders with more obstacles and hazards to movement than do low mountains.

Other classifications have been designated by other sources…CGSC, Military Review Combat at High Altitude lists three classifications Low (600-1500 meters), Medium (1500 to 3500 meters) and High Altitude Mountains (above 3500 meters).

Terrain: General Categories of Mountains

- ***Low Mountains***
  - ***Local relief of 1000-3000 ft.***
  - ***Usually below timberline***
- ***High Mountains***
  - ***Local relief of 3000 ft. +***
  - ***High alpine zones above timberline***
  - ***Glaciers and perennial snow cover***
  - ***Effects of altitude***

ELO B

ACTION	Describe the classifications of terrain
CONDITION	In a classroom environment
STANDARD	Describe the classifications of terrain IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations.

Learning Step/Activity 1 – Terrain classification

a. (Slide 7) The military uses the terms unrestricted, restricted and severely restricted to classify terrain. Mountainous terrain can be classified by the equipment and techniques required to conduct movement. This system is known as the modified Walzenbach rating system. There are at least six others used throughout the world. This system provides us with a well-known and commonly used reference. The classes of difficulty listed here do not take weather into account. (Read from slide here and discuss).

Terrain: Classification

Class 1 - Gentler slopes/trails; walking techniques

Class 2 - Steeper/rugged terrain; some use of hands

Class 3 - Easy climbing; fixed ropes where exposed

Class 4 - Steep/exposed climbing; fixed ropes required

Class 5- Near vertical; technical climbing required

ELO C

ACTION	List the mountain terrain features
CONDITION	In a classroom environment
STANDARD	List the mountain terrain features IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations.

Learning Step/Activity 1 – Mountain specific terrain features
a. (Slide 8) There are 10 terrain features that we commonly use during land navigation exercises as listed in FM 21-26 that you are familiar with: hill, saddle, valley, ridge, depression, draw, spur and cliff, cut and fill.

In addition to the 10 terrain features we have additional features that are used for reference in the mountains: peak or summit, horn or gendarme, pass, escarpment, buttress, glacier, gully or couloir.

Terrain: Mountain Specific Terrain Features

- ***Peak/Summit: the highest point of a mountain***
- ***Arete: a sharp, narrow mountain ridge or spur***
- ***Cirque: a bowl, usually with higher ground on 3 sides***
- ***Col: a small, high pass***
- ***Couloir: a steep, mountainside gully***
- ***Horn/Gendarme: an abrupt, sharp peak usually occurring on a ridge***
- ***Glacier: perennial accumulation of snow and ice***
- ***Pass: low point on a ridge with significant higher ground on each side; a saddle or col***
- ***Escarpment: a steep slope or cliff usually separating two level surfaces***
- ***Buttress: a rock formation that projects out from the line of the face***

b. (Slide 9) An arete is a narrow sharp spur or ridge.

Arete: Spur

c. (Slide 10) A cirque is a bowl usually with high ground on three sides

Cirque: Draw

d. (Slide 11) A col is a small, high mountain pass.

Col: Saddle

e. (Slide 12) A couloir is a steep mountainside gully

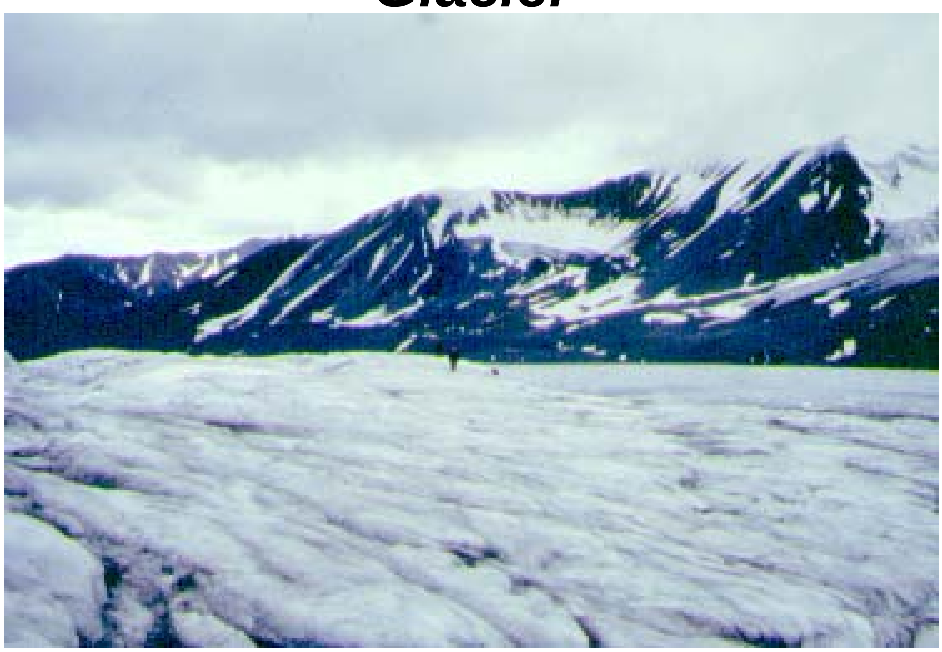
Couloirs: Draw

f. (Slide 13) A gendarme or horn is an abrupt sharp peak usually on a ridge that can present a significant obstacle.

Gendarme or Horn

g. (Slide 14) A glacier is a perennial accumulation of snow and ice

Glacier



h. (Slide 15**)** A Pass is a low point on a ridge with significant high ground on each side

Pass: Saddle or Valley

i. (Slide 16) the highest point on a mountain

Summit

ELO D	**ACTION**	Identify slope surfaces common to mountainous terrain
	CONDITION	In a classroom environment
	STANDARD	Identify slope surfaces common to mountainous terrain IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations.

Learning Step/Activity 1 – Slope surfaces
a. (Slide 17) It is also important to identify and evaluate the slope surfaces to understand how travel will be affected. Each slope type offers degrees of difficulty for traveling up or down. There are generally 4 types of slope surfaces: hard pack, grassy, talus, and scree.

1. Hard pack is considered earth that will not give way under the weight of an individual. It usually consists of packed dirt or sand and may contain scattered rocks and vegetation.
2. A grassy slope is seldom covered with a smooth carpet of green grass. Movement techniques are the same as on hard pack.
3. Talus slopes generally offer a fairly easy accent. One must avoid dislodging rocks, which could cause larger rocks to break loose and injure someone below. It is difficult to descend on this slope rapidly.
4. Scree slopes act like sand underfoot and can be very tiring on the ascent. Steps often can be kicked into scree on the ascent, but offer an easier decent where one can move with a sliding action.

Techniques for negotiating these slopes surfaces will be discussed in the mountain walking techniques portion of training.

Terrain: Slope Surfaces

- ***Hard Pack- soil with sparse vegetation that will not give way underfoot***
- ***Grassy- made up of grassy clumps (tussocks) or carpeted with alpine tundra***
- ***Talus - slopes comprised of large rocks/boulders formed from rockfall accumulation***
- ***Scree - slopes comprised of smaller rocks/gravel formed from rockfall accumulation, will give under body weight***

b. (Slide 18) Snow adds another dimension to mountain travel. Unlike rock surfaces, snow is in a state of constant change as does the temperature, wind, and precipitation. Route planning must take into account snow consistency and dangers that might be covered by what appears to be a solid surface. Effective travel through rugged terrain often involves special techniques; and over more inclined surfaces use of additional specialized equipment. These techniques will be demonstrated in more detail during the field training portion of training.

Terrain: Snow Surface Considerations

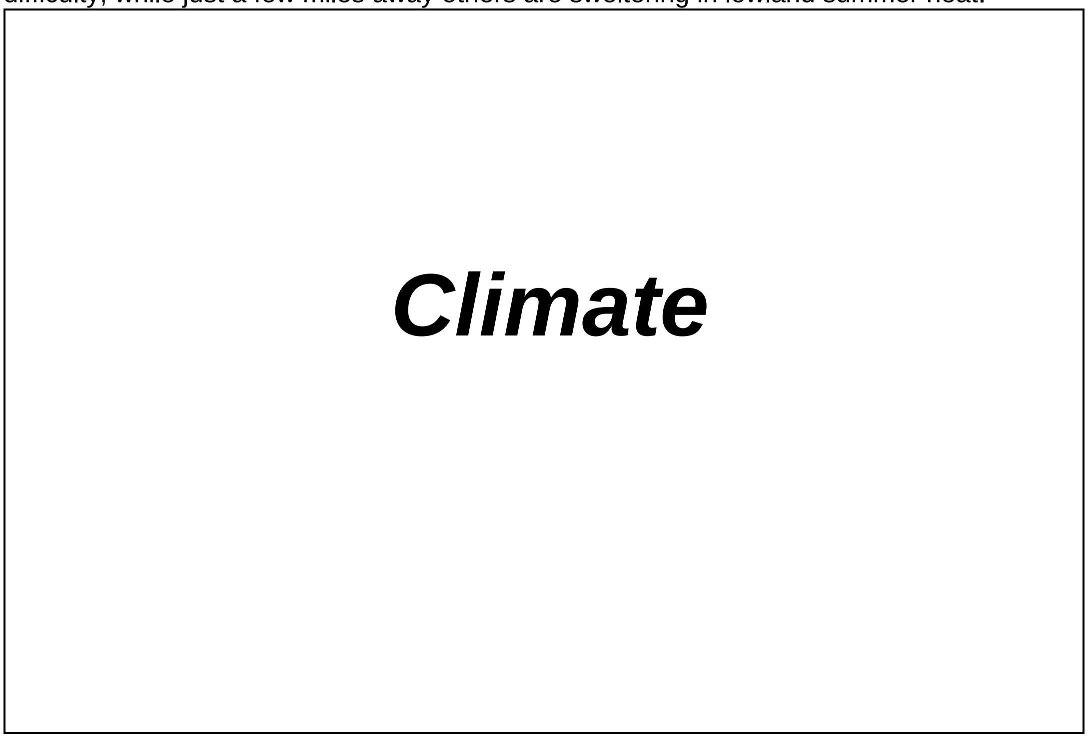
- ***Can aid movement by covering rough terrain with a consistent surface***
- ***May require special training and equipment - glaciers***
- ***May require snowshoes or skis to help with movement***
- ***Presents new hazards (avalanche, cornice collapse, etc.)***

ELO E

ACTION	Describe the climatic conditions in mountain regions
CONDITION	In a classroom environment.
STANDARD	Describe the climatic conditions in mountain regions IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations.

Learning Step/Activity 1 – Climatic conditions of mountain regions

a. (Slide 19) We will now discuss general climate features of mountain environments.
An analysis of mountain climate and how it is affected by mountain terrain shows that mountain weather is subject to changing patterns of extreme severity. Weather not only changes with astonishing rapidity in the mountains, but also its pattern and effects may be surprisingly local. Personnel caught unprepared for wind and rain on exposed alpine slopes may experience great difficulty, while just a few miles away others are sweltering in lowland summer heat.



b. (Slide 20) Mountains generally are influenced by either a continental or maritime influence. A continental climate is any climate not influenced by a large body of water. It can have little to heavy precipitation with most occurring on the leeward side of mountains. Strong winds are common, especially in mountains. Temperatures can very from extreme hot to extreme cold depending on the location. The Rocky mountains are an example of a continental zone as they are inland and no major body of water surrounds/influences them.

Continental Zone

- ***Light to heavy precipitation***
- ***Strong winds common***
- ***Hot summers / cold winters***

(Slide 21) A maritime climate is one that is influenced by a large body of water be it an ocean or a very large lake like the great lakes. It normally has moderate to heavy precipitation. The winds in this climate normally come from the water. The temperatures are milder due to the effect of the body of water. The Cascade Range of the Pacific Northwest is in a maritime zone because of the influence of the Pacific Ocean.

Maritime Zone

- ***Moderate to heavy precipitation***
- ***Winds from large bodies of water***
- ***Cool summers / mild winters***

c. (Slide 22) The climate conditions of most mountain regions can be classified into either cold wet conditions or cold dry conditions. In cold wet conditions, temperature range is approximately +14°F and up. Precipitation is usually in the form of sleet, rain, and wet or slushy snow. At times the ground will become muddy with wet or slushy snow. Variations in day and night temperatures create a constant freeze- thaw cycle. The coastal mountains of the Pacific Northwest would be an example of cold wet conditions.

Cold Wet Conditions

- ***Temperature- ranges from 14°F and above***
- ***Precipitation- rain, sleet, snow (wet or dry)***
- ***Ground- muddy, wet slushy snow***
- ***Constant freeze / thaw cycle***

(Slide 23) Temperature range is approximately +14°F and below. Precipitation is predominately fine dry snow. Ground remains frozen throughout entire winter.
Freeze thaw cycles are rare. The White Mountains north of Fairbanks Alaska have cold dry conditions for most of the year. Summer periods are the exception to this rule and can be very wet.

Cold Dry Conditions

- ***Temperature- ranges from 14°F and below***
- ***Precipitation- dry snow***
- ***Ground- frozen throughout winter***
- ***Freeze / thaw cycles are rare***

d. (Slide 24&25) These are more generalizations true of most mountainous environments. Pressure is lower in mountainous areas due to the altitude. The barometer generally drops 1 inch for every 1000 ft. gained in elevation. In mountainous environments movement is often restricted due to terrain and weather. The erratic weather requires that soldiers be prepared for alternating periods of heat and cold. Additionally, movement above the tree-line vastly reduces the amount of protective cover afforded by vegetation at lower elevations. The logistical problems will be acute; each man must be as self-sufficient as possible and able to cope with normal weather changes using materials from his own pack. Above approximately 5000 ft., depending on the specific region, snow can fall anytime of the year. Excessive snowfall brings avalanche hazards to exposed slopes and can force changes in previously selected routes. Mountain air is considerably dryer than air at sea level. Due to this increased dryness, equipment does not rust as quickly, and organic matter decomposes more slowly. Winds are normally much stronger and more variable in mountains. The normal high altitude prevailing winds are channeled by mountainous terrain causing them to gain in force. Each time the wind speed doubles, its force against an object is quadrupled. Heat also has an effect on wind; the passage of the sun across a mountain range generally causes a valley breeze in the morning and a mountain breeze in the afternoon and evening. Local winds assume a highly erratic pattern due to the sun shining with varying degrees of intensity on the uneven terrain.

Mountain Climates

- ***Generally cooler, wetter version of nearby lowlands***
- ***Maritime vs. Continental influence***
- ***Climate variations more drastic in high mountains***
- ***Major differences due to changes in altitude and relief***

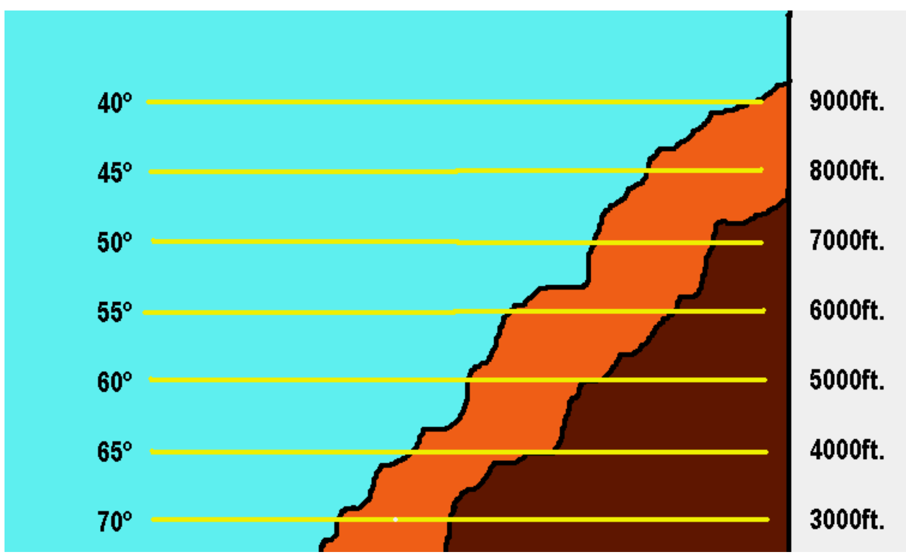
Mountain Climates

Temperature:

- ***Typically, temperature decreases 3-5º degrees (F) for every 1000 ft. gain in elevation***
- ***Temperature inversion- during clear, calm weather, evening valley temperatures may be significantly cooler than those higher upslope***
- ***Temperature inversions are common in the daytime during winter***

c. (Slide 26) This is a graphic representation of the decrease in temperature as the altitude increases.

Temperature Change as Altitude Increases



ELO F	**ACTION**	Describe how weather is created and describe indicators of bad weather
	CONDITION	In a classroom environment
	STANDARD	Describe how weather is created and describe indicators of bad weather IAW the NWTC Mountain Operations Handbook and FM 3-97.61 Military Mountaineering.

Learning Step/Activity 1 – Basics of weather

a. (Slide 27) We will now discuss weather. The severity and variance of weather in mountainous regions causes it to have a major impact on military operations. Predicting mountain weather is often a fool's game, but predictions based on weather signs that have been past indicators may have a degree of accuracy. Some weather lore is based upon well understood weather phenomena and may aid soldiers. Most people subconsciously forecast the weather. If they look outside and see dark clouds they may decide to take rain gear. If an unexpected wind strikes people look to the sky for other bad signs. A conscious effort to follow weather changes will ultimately lead to a more accurate forecast

b. (Slide 28) Weather Basics: The earth is surrounded by an atmosphere that is divided into several layers. The world's weather systems are in the lower of these layers known as the troposphere. This layer reaches as high as 40,000 feet. Weather is a result of atmosphere, oceans, land masses, unequal heating and cooling from the sun and the earth's rotation. The weather found in any one place depends upon many things such as the air temperature, humidity (moisture content), air pressure (barometric pressure), how air is being moved, and if it is being lifted or not.
Air pressure is the weight of the atmosphere at any given place. The higher the pressure, the better the weather will be. With lower air pressure, the weather will more than likely be worse. In order to understand this, imagine that the air in the atmosphere acts like a liquid. Areas with high levels of this liquid exert more pressure on an area and are called high pressure areas. Areas with a lower level are called low pressure areas. The average air pressure at sea level is 29.92 inches of mercury (hg) or 1,013 milibars (mb). The higher in altitude, the lower the air pressure.

(1) High pressure areas have the following characteristics:

- The airflow is clockwise and out
- Otherwise known as an anticyclone
- Associated with clear skies
- Generally the winds will be mild
- Depicted as a blue H on weather maps

(2) Low pressure areas have the following characteristics:

- The airflow is counterclockwise and in
- Otherwise known as cyclone
- Associated with bad weather
- Depicted as a red L on weather maps

Air from a high pressure area is basically trying to flow out and equalize its pressure with the surrounding air. Low pressure on the other hand, is building up vertically by pulling air in from outside itself, which causes atmospheric instability resulting in bad weather.

On a weather map, these differences in pressure are depicted as isobars. Isobars resemble contour lines and are measured in either milibars or inches of mercury. The areas of high pressure are called ridges and the lows are called troughs.

c. Winds. In high mountains, the ridges and passes are seldom calm; however, strong winds in protected valleys are rare. Normally, wind speed increases with altitude since the earth's frictional drag is strongest near the ground. This effect is intensified by mountainous terrain. Winds are accelerated when they converge through mountain passes and canyons. Because of these funneling effects, the wind may blast with great force on an exposed mountainside or summit. Usually, the local wind direction is controlled by topography.

(1) The force exerted by wind quadruples each time the wind speed doubles; that is wind blowing at 40 knots pushes four times harder than a wind blowing at 20 knots. With increasing wind strength, gusts become more important and may be 50 percent higher than the average wind speed.

(2) Winds are formed due to the uneven heating of the air by the sun and rotation of the earth. Much of the world's weather depends upon a system of winds that blow in a set direction.

(3) Above hot surfaces, air expands and moves to colder areas where it cools and becomes denser, and sinks to the earth's surface. The results are a circulation of air from the poles along the surface of the earth to the equator, where it rises and moves to the poles again.

(4) Heating and cooling together with the rotation of the earth causes surface winds. In the Northern Hemisphere there are three prevailing winds:

- Polar Easterlies. These are winds from the polar region moving from the east. This is air that has settled at the poles.
- Prevailing Westerlies. These winds originate from approximately 30 degrees north latitude from the west. This is an area where prematurely cooled air, due to the earth's rotation, has settled to the surface.
- Northeast Trade Winds. These are winds that originate from approximately 30 degrees north from the northeast.

(5) The jet stream is a long meandering current of high speed winds often exceeding 250 miles per hour; it is located near the transition zone between the troposphere and the stratosphere known as the tropopause. These winds blow generally from a westerly direction dipping down and picking up air masses from the tropical regions and going north and bringing down air masses from the polar regions.

(6) The patterns of wind mentioned above move air. This air comes in parcels called air masses. These air masses can vary from the size of a small town to as large as a country. The air masses are named from where they originate:

- Maritime – over water
- Continental – over land
- Polar – north of 60 degrees north latitude
- Tropical – south of 60 degrees north latitude

Combining these parcels of air provides the names and descriptions of the four types of air masses:

- Continental Polar – cold, dry air mass
- Maritime Polar – cold, wet air mass
- Maritime Tropical – warm, wet air mass
- Continental Polar - warm, dry air mass

d. Humidity is the amount of moisture in the air. All air holds water vapor even if it cannot be seen. Air can hold only hold so much water vapor; however, the warmer the air, the more moisture it can hold. When the air holds all that it can, the air is saturated or has 100 percent relative humidity.

(1) If air is cooled beyond its saturation point, the air will release its moisture in one form or another (clouds, fog, rain, snow etc.). The temperature at which this happens is called the condensation point. The condensation point varies depending upon the amount of water vapor contained in the air and the temperature of the air. If the air contains a great deal of water, condensation can occur at temperatures of 68 degrees F, but if the air is dry and does not hold

much moisture, condensation may not form until the temperature drops to 32 degree F or even below freezing.

(2) The adiabatic lapse rate is the rate at which air cools as it rises or warms as it descends. This rate varies depending on the moisture content of the air. Saturated air will warm and cool approximately 3.2 degree F per 1,000 feet of elevation gained or lost. Dry air will warm and cool approximately 5.5 degree F per 1,000 feet of elevation gained or lost.

e. Temperature. Normally a drop of 3-5 degrees Fahrenheit for every 1,000 feet gain in altitude is encountered in motionless air. For air moving up a mountain with condensation occurring, the temperature of the air drops 3.2 degrees F with every 1,000 feet gain. For air moving up a mountain with no clouds forming, the temperature of the air drops 5.5 degrees F for every 1,000 feet of elevation gain.

Weather results from:

Atmosphere, oceans, land masses, heating and cooling from the sun and the earth's rotation

Weather depends upon:

Air temperature, humidity, air pressure, how air is being moved and if the air is being lifted or not

You should observe:

Pressure, wind direction/speed, cloud cover, temperature and humidity to help predict weather

Some tools that you can use are thermometer, barometer/altimeter and wind meter.

Learning Step/Activity 2 – Cloud Formation

a. (Slide 29 & 30) Clouds are indicators of weather conditions. By reading clouds shapes and patterns observers can forecast weather without any extra equipment. Any time air is cooled or lifted beyond its saturation point (100 percent relative humidity), clouds are formed. There are four ways that air gets cooled beyond its saturation point and these are referred to as weather patterns:

Cloud Formation

Convective Lifting*:** ***Sun's heat radiating off the earth's surface causing air currents (thermals) to rise straight up and lift air to point of saturation.

Frontal Lifting*:** ***A front is formed when to air masses of different moisture content and temperature collide. Since air masses will not mix, the warmer air will lift until it reaches its saturation point. Produces majority of precipitation.

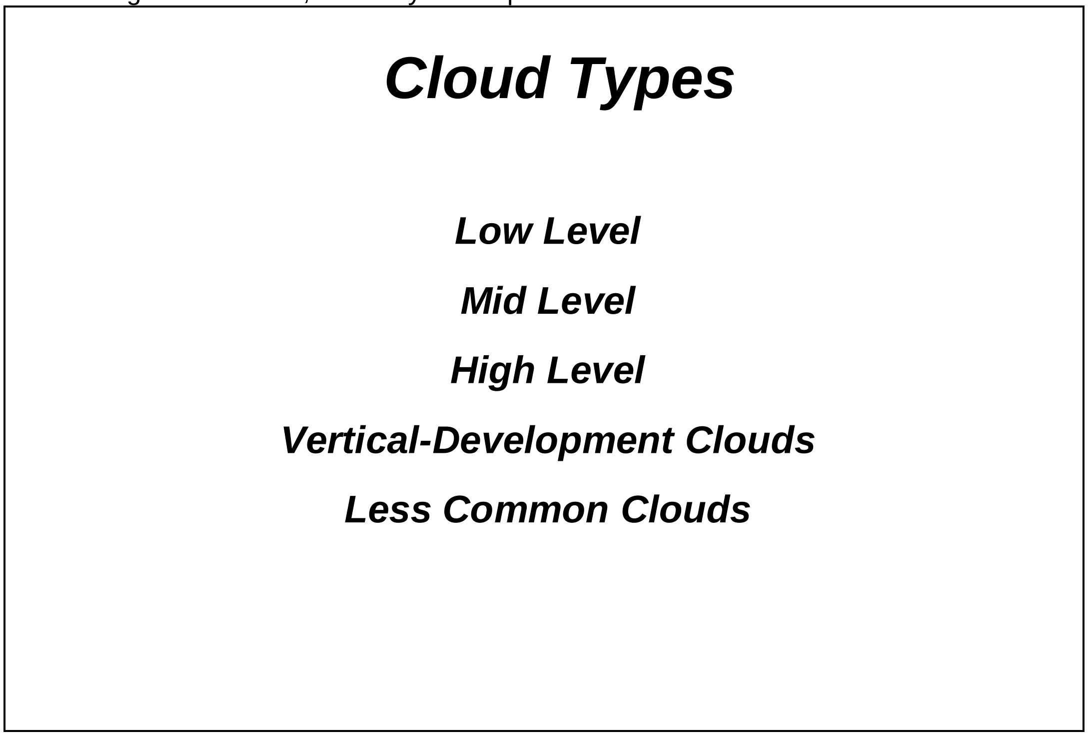
Cyclonic Lifting*:** ***An area of low pressure pulls air into its center from all over in a counterclockwise direction. Once air reaches the center of low pressure, it has nowhere to go but up. Air continues to lift until it reaches the saturation point.

Cloud Formation (cont.)

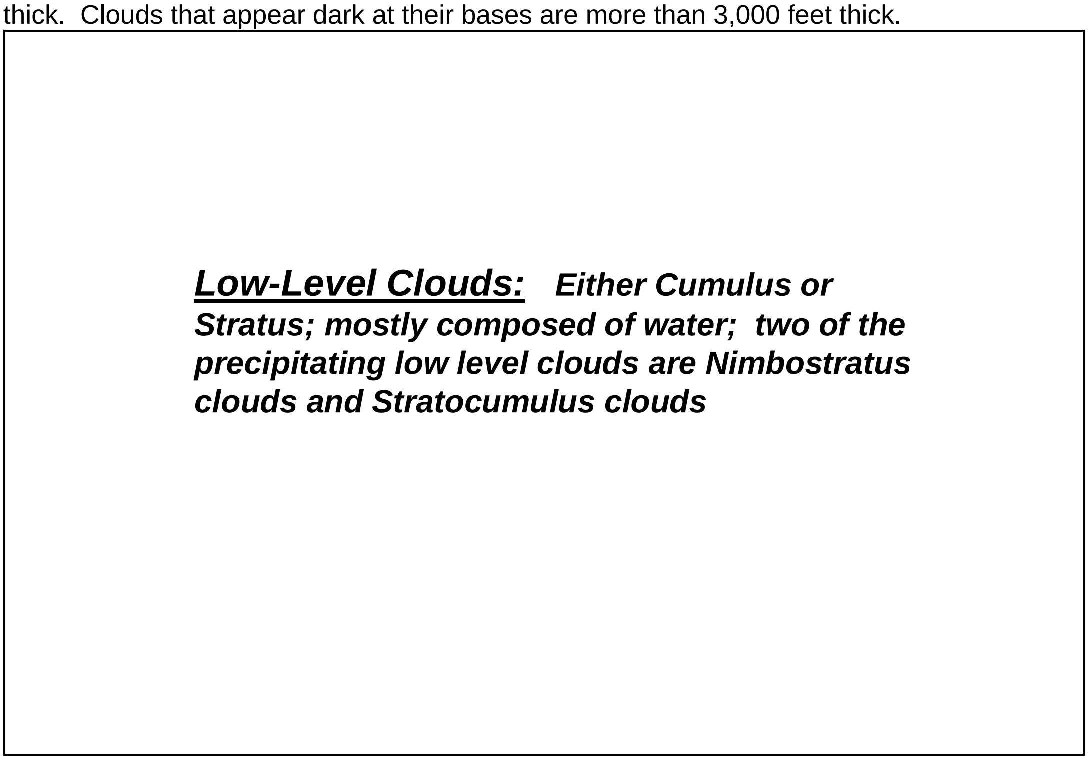
***Orographic Lifting*:** **This happens when an air mass is pushed up an over a mass of higher ground such as a mountain. This is typical along coast regions with mountains. As the air mass moves up the mountain range, the moisture is released quickly and typically produces heavy precipitation. This is evident in the Cascade Range of the Pacific Northwest.**

Learning Step/Activity 3 – Clouds Types

a. (Slide 31) There are different cloud formations that can help you to understand the weather. Clouds can be described in many ways. They can be classified by height or appearance, or even by the amount of area covered vertically or horizontally. Clouds are classified into five categories: Low, mid and high level clouds, vertically developed clouds and less common clouds.



b. (Slide 32) Low level clouds (0-6,500 feet) are either cumulus or stratus. Low-level clouds are composed mainly of water droplets since their bases lie below 6,500 feet. When temperatures are cold enough, these clouds may also contain ice particles and snow. Low-level clouds may be identified by their height above nearby surrounding relief of known elevation. Most precipitation originates from low-level clouds because rain or snow usually evaporates before reaching the ground from higher clouds. Low-level clouds usually indicate impending precipitation, especially if the cloud is more than 3,000 feet thick. Clouds that appear dark at their bases are more than 3,000 feet thick.



c. (Slide 33) Indicates fair weather.

Cumulus Clouds: Low level; fair weather

d. (Slide 34) Indicates fairly stable weather.

Stratus Clouds Low level: fair weather

e. (Slide 35) Nimbostratus clouds are dark low-level clouds accompanied by light to moderately falling precipitation. The sun or moon is not visible through nimbostratus clouds, which distinguishes them from mid-level altostratus clouds. Because of the fog and falling precipitation commonly found beneath and around nimbostratus clouds, the cloud base is extremely diffuse and difficult to accurately determine.

Nimbostratus Clouds: Low level

f. (Slide 36) Stratocumulus clouds generally appear as a low, lumpy layer of clouds that is sometimes accompanied by weak precipitation. Stratocumulus vary in color from dark gray to light gray and may appear as rounded masses with breaks of clear sky in between. Because the individual elements of stratocumulus are larger than those of the mid level cloud, altocumulus, deciphering between the two cloud types is easier. With your arm extended toward the sky, altocumulus cloud (a mid-level cloud) elements are about the size of a thumbnail, while stratocumulus elements are about the size of a fist.

Stratocumulus Clouds: Low level

g. (Slide 37) Mid-level clouds (between 6,500 to 20,000 feet) have a prefix of alto. Middle clouds appear less distinct than low clouds because of their height. Alto clouds with sharp edges are warmer because they consist of water droplets. Cold clouds, composed mainly of ice crystals and usually colder than – 30 degrees F, have distinct edges that grade gradually into the surrounding sky. Middle clouds usually indicate fair weather, especially if they are rising over time. Lowering middle clouds indicate potential storms, though usually hours away. There are two types of mid-level clouds, altocumulus and altostratus clouds.

<u>Mid-Level Clouds:</u> ***Middle clouds generally indicate fair weather, especially if they are rising over time. These clouds have the prefix 'alto'. Deteriorating weather is indicated by lowering middle clouds though these storms are usually hours away.***

h. (Slide 38) Altocumulus clouds can appear as parallel bands or rounded masses. Typically a portion of an altocumulus cloud is shaded, a characteristic which makes them distinguishable from high-level cirrocumulus. Altocumulus clouds usually form in advance of a cold front. The presence of altocumulus clouds on a warm humid summer morning is commonly followed by a thunderstorm later in the day. Altocumulus clouds that are scattered rather than even are often called fair weather cumulus and suggest the arrival of high pressure and clear skies.

Altocumulus Clouds: Mid level

i. (Slide 39) Altostratus clouds are often confused with the high level cirrostratus clouds. The one distinguishing feature is that a halo is NOT observed around the sun or moon with altostratus. Also, with altostratus the sun or moon is only vaguely visible and appears as if it were shining through frosted glass.

Altostratus Clouds: Mid level

j. (Slide 40) High level clouds (more than 20,000 feet above the ground) are usually frozen clouds, indicating air temperatures below -30 degrees Fahrenheit, with a fibrous structure and blurred outlines. The sky is often covered with a thin veil of cirrus that partly obscures the sun or, at night produces a ring of light around the moon. The arrival of cirrus clouds indicates moisture aloft and the approach of a traveling storm system. Precipitation is often 24-36 hours away. As the storm approaches the cirrus thickens and lowers, becoming altostratus and eventually stratus. Temperatures warm, humidity rises and winds become southerly or south easterly. The two types of high level clouds are cirrus and cirrostratus.

High-Level Clouds: ***These clouds are in the upper reaches of the troposphere and indicate moisture aloft and that precipitation is 24-36 hours away. Cirrus and Cirrostratus are the most common. The only indicators of these clouds may be a halo or ring around the moon or sun.***

k. (Slide 41) Cirrus clouds are the most common of high-level clouds. Typically found at altitudes greater than 20,000 feet, cirrus are composed of ice crystals that form when super-cooled water droplets freeze. Cirrus clouds generally occur in fair weather and point in the direction of air movement at their elevation. Cirrus can be observed in a variety of shapes and sizes. They can be nearly straight, shaped like a comma, or seemingly all tangled together. Extensive cirrus clouds are associated with an approaching warm front.

Cirrus Clouds: High level

l. (Slide 42) Cirrostratus clouds are sheet like, high level clouds composed of ice crystals. They are relatively transparent and can cover the entire sky and be up to several thousand feet thick. The sun or moon can be seen through cirrostratus. Sometimes the only indication of cirrostratus clouds is a halo around the sun or the moon. Cirrostratus clouds tend to thicken as a warm front approaches, signifying an increased production of ice crystals. As a result, the halo gradually disappears and the sun or moon becomes less visible.

Cirrostratus Clouds: High level

m. (Slide 43) Clouds with vertical development can grow to heights in excess of 39,000 feet, releasing incredible amounts of energy. The two types of clouds with vertical development are fair weather cumulus and cumulonimbus.

(1) Fair weather cumulus clouds have the appearance of floating cotton balls and have a lifetime of 5-40 minutes. Known for their flat bases and distinct outlines, fair weather cumulus exhibit only slight vertical growth, with the cloud tops designating the limit of rising air. Given suitable conditions, however, these clouds can later develop into towering cumulonimbus clouds associated with powerful thunderstorms. Fair weather cumulus clouds are fueled by buoyant bubbles of air known as thermals that rise up from the earth's surface. As the air rises, the water vapor cools and condenses forming water droplets. Young fair weather cumulus clouds have sharply defined edges and bases while the edges of older clouds appear more ragged, an artifact of erosion. Evaporation along the cloud edges cools the surrounding air, making it heavier and producing sinking motion outside the cloud. This downward motion inhibits further convection and growth of additional thermals from down below, which is why fair weather cumulus typically have expanses of clear sky between them. Without a continued supply of rising air, the cloud begins to erode and disappears eventually.

(2) Cumulonimbus clouds are much larger and more vertically developed than fair weather cumulus. They can exist as individual towers or form a line of towers called a squall line. Fueled by vigorous convective updrafts, the tops of cumulonimbus clouds can reach 39,000 feet or higher. Lower levels of cumulonimbus clouds consist mainly of water droplets, while at higher elevations, where temperatures are well below freezing, ice crystals dominate the composition. Under favorable conditions, harmless fair weather cumulus clouds can quickly develop into large cumulonimbus clouds associated with powerful thunderstorms, known as super-cells. Super-cells are large thunderstorms with deep rotating updrafts and can have a lifetime of several hours. Super-cells produce frequent lightening, large hail, damaging winds and tornadoes. These storms tend to develop during the afternoon and evening when the effects of heating from the sun are strongest.

Vertical Development Cloud Formations

Fair Weather Cumulus: ***resemble floating cotton balls with a short lifespan***

Cumulonimbus: ***generally in the shape of anvils. Produce the majority of thunderstorms.***

n. (Slide 44) Thunderhead. Impending thunderstorms.

Cumulonimbus Clouds: Thunderhead

o. (Slide 45) Less Common Clouds:

(1) Orographic or lenticular clouds develop in response to the forced lifting of air by the earth's topography. Air passing over a mountain oscillates up and down as it moves downstream. Initially, stable air encounters a mountain and is lifted upward and cools. If the air cools to its saturation point during this process, the water vapor condenses and becomes visible as a cloud. Upon reaching the mountain top, the air is heavier than the environment and will sink down the other side, warming as it descends. Once the air returns to its original height, it has the same buoyancy as the surrounding air. However, the air does not stop immediately because it still has momentum carrying it downward. With continued descent, the air becomes warmer and ascends back to its original height. Lenticular clouds are cloud caps that often form above pinnacles or peaks and usually indicate higher winds aloft. Cloud caps with a flying saucer shape, indicate extremely high winds (over 40 knots). Lenticular clouds should always be watched for changes; if they grow and descend, bad weather can be expected.

(2) Contrails are clouds that are made by water vapor being inserted into the upper atmosphere by the exhaust of jet engines. Contrails evaporate rapidly in fair weather. If it takes longer than two hours for contrails to evaporate, then there is impending bad weather.

Less Common Cloud Formations

Orographic or Lenticular Clouds: ***Look similar to contact lenses. Indicate poor weather in the near future.***

Contrails: ***Exhaust from jets creates clouds in the upper atmosphere; evaporate quickly in fair weather; contrails that takes longer than 2 hours to evaporate indicate impending bad weather***

p. (Slide 46) High winds aloft; indicates approaching storm.

Lenticular Clouds

q. (Slide 47) High winds aloft; indicates approaching storm.

Lenticular Clouds

Learning Step/Activity 4: Fronts

a. (Slide 48) Fronts occur when two air masses of different moisture and temperature contents meet. One of the four indicators that a front is approaching is the progression of the clouds. The four types of fronts are as follows:

(1) Warm Front: A warm front occurs when warm air moves into and over a slower or stationary cold air mass. Because warm air is less dense, it will rise up and over the cooler air. The cloud types seen when a warm front approaches are cirrus, cirrostratus, nimbostratus (producing rain) and fog. Occasionally, cumulonimbus clouds will be seen during the summer months.

(2) Cold Front: A cold front occurs when a cold air mass overtakes a slower or stationary warm air mass. Cold air being more dense than warm air will force the warm air up. Clouds observed will be cirrus, cumulus and then cumulonimbus producing a sort period of showers

(3) Occluded Front: Cold fronts generally move faster than warm fronts. The cold fronts eventually overtake warm fronts and the warm air becomes progressively lifted from the surface. The zone of division between the cold air ahead and cold air behind is called a cold occlusion. If the air behind the front is warmer than the air ahead it is a warm occlusion. Most land areas experience more occlusions than any other types of fronts. The cloud progression observed will be cirrus, cirrostratus, altostratus, and nimbostratus. Precipitation can be from light to heavy.

(4) Stationary Front: A stationary front is a zone with no significant air movement. When a warm or cold front stops moving, it becomes a stationary front. Once this boundary begins moving again, it once again becomes a warm or a cold front. When crossing from one side of a stationary front to the other there is typically a noticeable temperature change and shift in wind direction. The weather is typically clear to partly cloudy along the stationary front.

Fronts

Warm Front: warm air mass moves into and over a cold air mass; forms cirrus, cirrostratus, nimbostratus, and fog.

Cold Front: cold air mass overtakes a slower or stationary warm air mass; cold air forces the warm air up; forms cirrus, cumulus and then cumulonimbus producing a short period of showers

Occluded Front: Occurs frequently over land; progress from cirrus to cirrostratus to altostratus to nimbostratus (precipitation)

Stationary Front : no significant air movement; clear to partly cloudy weather along the front

Learning Step/Activity 5 – Indicators of poor weather

a. (Slide 49) During the Military Decision Making Process (MDMP), weather must be given significant consideration. Mountain and cold weather operations can quickly turn into an exercise in survival if weather conditions are ignored. Indications of deteriorating weather conditions can allow unit leaders to prepare for the worst, or reconsider the manner of execution to use those weather conditions to advantage. All of these signs indicate a shift of the current weather:

(1) Plumes of blowing snow off ridges and peaks
(2) Formation of lens-shaped clouds or lenticular clouds
(3) Mares Tales (Cirrus Clouds)
(4) Lowering, thickening cloud layers
(5) Various abundant cloud layers
(6) Halo around the sun or moon
(7) Cumulus clouds forming throughout the day

(8) Thunderheads (cumulonimbus clouds)
(9) Falling barometer, (if using an altimeter the indicated altitude will increase)

Weather Prediction

Some of the indicators that weather conditions will change/deteriorate significantly in the near future are:

•Thickening, lowering clouds

•Lenticular Cloud formation

•Marked wind increases or direction shifts

•Marked change in temperatures

•Decreasing barometric pressure

ELO G

ACTION	Identify mountain hazards
CONDITION	In a classroom environment.
STANDARD	Identify mountain hazards IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations

Learning Step/Activity 1 – Mountain Hazards

a. (Slide 50) There are numerous objective hazards present in the mountains that must be considered. Ignorance of these hazards can lead to casualties and lost or damaged equipment.

Hazards of Mountainous Regions

Learning Step/Activity 2 – Altitude

a. (Slide 51) Altitude is another factor that can have a significant impact on operations. FM 3-97.6 classifies terrain altitude into five categories:

1. Low altitude – sea level to 5,000 feet; arterial blood saturation is 96 percent saturated
2. Moderate altitude – 5000-8000 feet; arterial saturation is 92 percent; effect of altitude are temporary
3. High altitudes – 8000-14000 feet; altitude illness common here
4. Very High altitude – 14000-18000; altitude illness the rule
5. Extreme altitude – areas above 18,000 feet

More on the effects of altitude is presented in the Medical Considerations Class.

Altitude

Low Altitude – Sea level to 5000 feet; arterial blood saturation is 96 percent saturated

Moderate Altitude – 5000-8000 feet; arterial saturation is 92 percent; effects of altitude are temporary

High Altitude – 8000-14000 feet; altitude illness common

Very High Altitude – 14000-18000 feet; altitude illness the rule

Extreme Altitude – above 18000

Learning Step/Activity 3 – Visibility
a. (Slide 52) Visibility may be affected by the unique conditions found in a mountainous environment:
(1) Whiteout can be created by winds and blowing snow, a heavy volume of falling snow or by light filtering through a cloud cover creating 'flat light' conditions that cause a loss of depth perception due to the inability to distinguish variations in terrain.
(2) A **blizzard** is a severe weather condition characterized by low temperatures, winds 35 mph or greater, and sufficient falling and/or blowing snow in the air to frequently reduce visibility to 1/4 mile or less for a duration of at least 3 hours. A severe blizzard is characterized by temperatures near or below 10°F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

Visibility

Learning Step/Activity 4 – Avalanche is nothing more than a mass of snow moving down a slope. More information on avalanches is presented in the Avalanche Hazards class.
a. (Slide 53) An avalanche is nothing more than a mass of snow moving down a slope. More information on avalanches is presented in the Avalanche Hazards class.
– this one was triggered by Canadian Army Artillery.

Avalanche

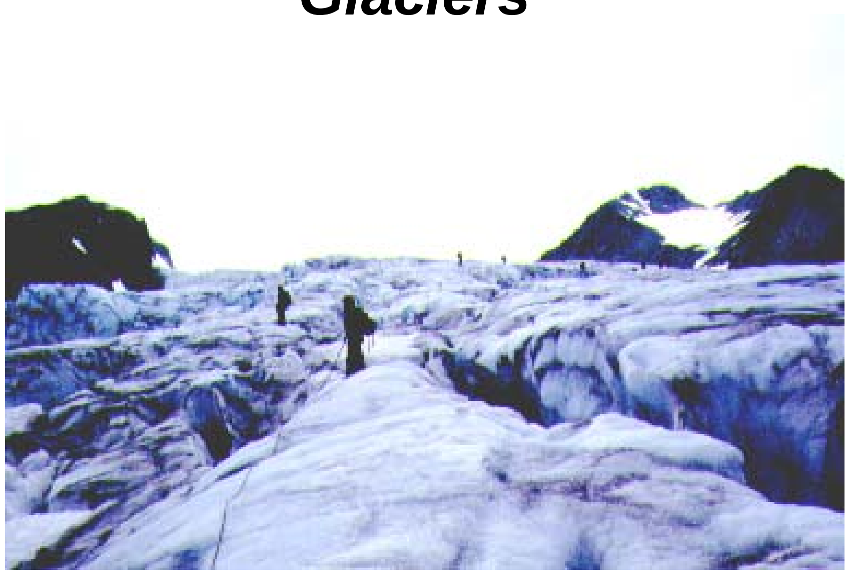
b. (Slide 54) Avalanche of ice and snow from a hanging glacier.

Avalanche

Learning Step/Activity 5 – Glaciers

a. (Slide 55) Glaciers are rivers of ice that develop over time because of a perennial accumulation of snow. Glaciers can provide fast, efficient movement or can be obstacles to movement depending upon the conditions. Roped glacier travel slows movement and increases concern for route selection.

Glaciers

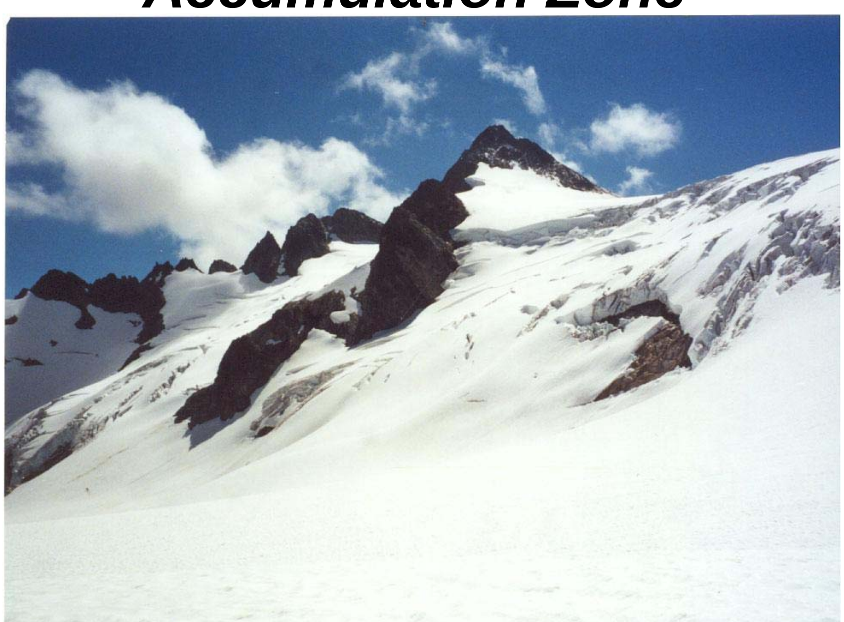


b. (Slide 56) A Crevasse is formed as a glacier flows over an irregularity causing a split or crack in ice surface.

Crevasse

c. (Slide 57) The Accumulation Zone is the zone of the glacier where snowfall exceeds snowmelt.

Accumulation Zone

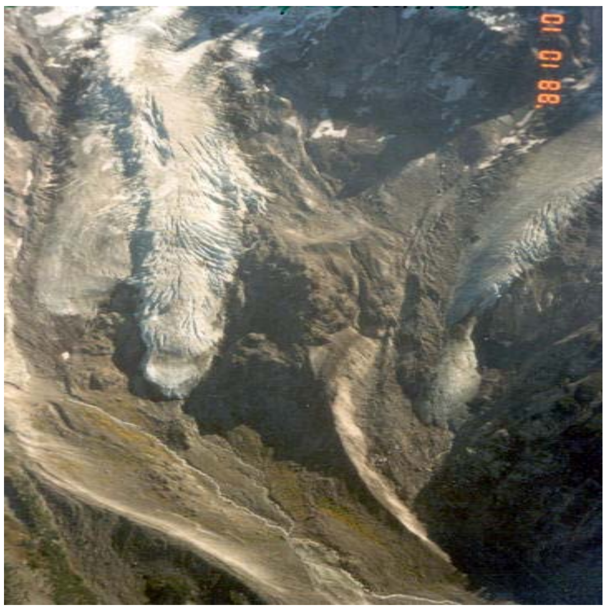


d. (Slide 58) **The Ablation Zone** is the section of the glacier where melting dominates.

Ablation Zone

e. (Slide 59) **A Moraine is a pile of debris carried down glacier and dumped at its end-terminus or lateral margin. Lateral Moraines** mark the edges of this glacier.

Lateral Moraine



f. (Slide 60) **An Icefall** is an area of rapid movement on a steep slope with extensive open crevassing.

Icefall

g. (Slide 61) **Terminus** is the end of the glacier.

Terminus

Learning Step/Activity 6 – Winds
a. (Slide 62)

Winds

Velocity increases with altitude and is further enhanced by rapid rise over mountain barrier (orographic lifting)

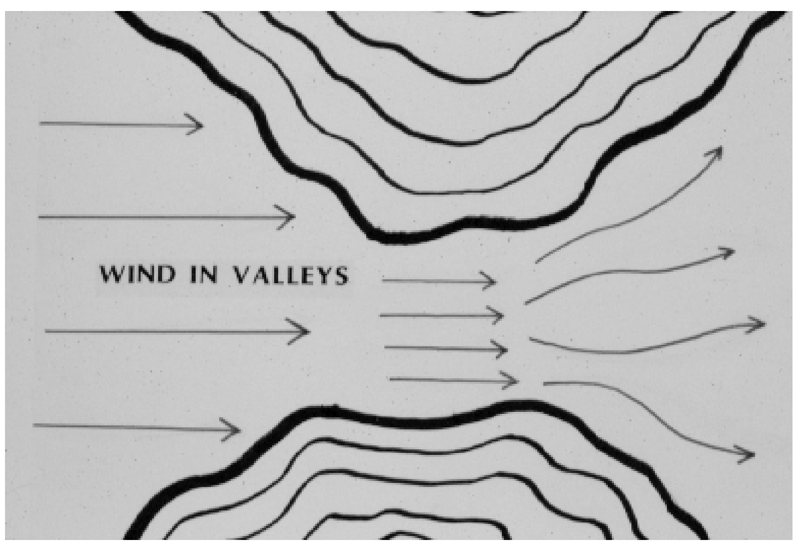
Velocity increases as wind funnels through narrowing valleys and passes (venturi effect)

As the wind speed doubles, its force on an object quadruples

Wind chill is another hazard created by winds

b. (Slide 63) Venturi effect in a narrowing pass.
Wind velocity increases as it is funneled through a pass.

Wind velocity increases as it moves through a narrow pass or col.



c. (Slide 64)

Wind Chill

AIR TEMPERATURE IN FAHRENHEIT

WIND SPEED	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95

WIND SPEED BASED ON MEASURES AT 33 FEET HEIGHT. IF WIND SPEED MEASURED AT GROUND LEVEL, MULTIPLY BY 1.5 TO OBTAIN WIND SPEED AT 33 FEET IN HEIGHT AND THEN UTILIZE CHART.

Learning Step/Activity 7 – Rivers

a. (Slide 65) Rivers found in cold regions may aid movements or be major obstacles, depending upon the time of year.

1. Arctic/Sub-Arctic rivers are usually glacier-fed, with many braided channels and swift currents.
2. Glacier-fed rivers change course frequently, making river navigation difficult, and rendering map data suspect.
3. If shallow-draught boats are available, rivers may provide valuable lines of communication in summer, and once firmly frozen, may offer high-speed routes for both mounted and dismounted movement. During spring and early winter (break-up and freeze-up) however, rivers may be impassable. Some rivers, especially in temperate areas, may not freeze solidly enough to allow for winter movement.

Rivers

- ***Majority of Arctic and Sub-Arctic rivers are glacier fed***
- ***Good transportation routes after freeze up***

b. (Slide 66)

Rivers

c. (Slide 67)

Rivers (cont.)

Learning Step/Activity 8 – Rockfall

a. (Slide 68) Rockfall is a frequent hazard in a mountainous environment and can present a significant hazard. In regions with snow cover, as temperatures warm during daylight hours, the bond that snow, ice and rock have with underlying layers is weakened, often creating rock and ice fall hazards. Personnel moving on steep terrain can dislodge loose rock and create a rockfall hazard to those below them.

Rockfall

Learning Step/Activity 9 – Lightning

a. (Slide 69) **Lightning** is frequent in the mountains and is normally attracted to high points, metal objects, and dominant features such as lone trees, buildings, and ridges. Lightning is a major hazard in the mountains and should always be treated with respect. Lightning can occur miles from an approaching or retreating thunderstorm, becoming a hazard. Lightning is the main hazard during a thunderstorm and accounts for many hundreds of deaths each year, with the most immediate danger due to cardiopulmonary arrest. The danger from lightning is greater on rock than on snow or ice.

Severe static electricity is a precursor to lightning. Lightning should be expected when static electricity is great enough to cause, tickling of the scalp, standing up of hair and/or light crackling and appearance of a blue light (St. Elmo's Fire) on metal objects.

Keep in mind that not only can a direct lightning strike halt your movement, but it can also prevent movement if a necessary rope or equipment was damaged. Lightning strikes can be categorized by the type of contact or effective contact with either humans or objects:

1. direct strikes- direct contact
2. splash strikes- jumps from a struck object to another
3. contact injury- touching an object that received a direct strike
4. step voltage- current transmitted on the surface, (rock, ground)
5. blunt trauma- shock wave from nearby strike

Lightning

- ***Continental ranges invite thunderstorm conditions more than maritime ranges***
- ***Topography of mountains contributes to the formation of thunderstorms***
- ***Ridges and peaks are focal points for lightning***
- ***Valley breeze in AM; mountain breeze in PM***

ELO H

ACTION	Take Precautionary Measures During an Electrical Storm
CONDITION	In a classroom environment.
STANDARD	Identify mountain hazards IAW the NWTC Mountain Operations Handbook and FM 3-97.6 Mountain Operations

Learning Step/Activity 1 – Precautions in a lightning storm
a. (Slide 70)

Precautions in a Lightning Storm

- ***Avoid high risk areas for bivouacs such as peaks and high passes***
- ***Take note of building cumulonimbus clouds and plan to be in a low risk area as the day progresses***
- ***If caught in a storm seek lower ground***
- ***Avoid wet lichen covered rock, drainages, standing under tall trees, shallow caves or overhangs and being connected to climbing ropes***
- ***Squat or sit on some sort of insulating material – sleeping pad or a bunched up climbing rope. Soldiers should be spaced at least 15 feet apart from each other.***

SECTION IV **SUMMARY**

Check on Learning

1. Name the ten mountain specific terrain features.
Arete, summit, couloir or gully, buttress, escarpment or cliff, col, pass, horn or gendarme, glacier, and cirque

2. What are some of the indicators that bad weather is approaching?
Lenticular clouds, marked shifts in temperature or winds, decrease in barometric pressure, snow plumes blowing off peaks and ridgelines

Review and Summarize Lesson

The Terminal Learning Objective for this lesson was:

ACTION	Describe the characteristics of mountain environments
CONDITION	In a classroom environment.
STANDARD	Describe the characteristics of mountain environments IAW the NWTC Mountain Operations Manual.

Transition to next lesson

As per NWTC training schedule; dependent upon course in conduct.

SECTION V	STUDENT EVALUATION
Testing Requirements	Students will be tested on their knowledge of the characteristics of mountain environments during a one hour written examination at the conclusion of the course (Refer to training schedule for date/time of exam).
Feedback Requirement	a. Instructors will reinforce this lesson during mountain walking physical training and land navigation preparation.